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PRACTICAL RESULTS OF TEN YEARS OF RANGE CONSERVATION AND EROSION CONTROL IN NORTHWESTERN NEW MEXICO

By

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INTRODUCTION

It is generally recognized that continued overgrazing initiates a chain of plant and soil reactions resulting in the deterioration or even the complete destruction of the perennial plant cover and the serious depletion of organic matter in the soil surface. Conditions arising from these results reduce water absorption and increase runoff, thus robbing the remaining vegetation of moisture and causing destructive erosion. It is equally recognized, too, that complete rest or light use for a long enough period usually would result in a partial or complete restoration of the vegetation of areas not already too badly eroded. What is not so well understood, but what material presented here is intended to show, is that this restoration may be achieved under a program of grazing which not only allows for range improvement, but which also maintains the income.

This work, which was carried out between 1934 and 1943 at the Navajo Experiment Station in northwestern New Mexico, did not extend for a sufficient period of time for significant changes in runoff to appear; but increases in plant vigor and decrease in some of the undesirable plants such as snakeweed (Gutierrezia sarothrae) together with localized increases in desirable forage species showed that the process of recovery was well underway.

The results of this study constitute an addition to an already impressive array of facts from throughout the country showing that methods which contribute to conservation of soil and water also contribute to the rancher's income.

LOCATION AND DESCRIPTION OF THE EXPERIMENTAL AREA

The Navajo Experiment Station area is located in McKinley County, northwestern New Mexico. The station comprises a small but almost complete drainage area, and, perhaps, is as typical of northwestern New

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Mexico as any one site could be. The experimental area includes slightly more than 67 sections of land, and the elevation ranges from 6,200 feet on the east to 8,120 feet on the west.

Climate

Monthly averages of climatic factors, as determined from data collected at an elevation of 6,437 feet, are given in Table 1, page 3. These data show that temperatures are moderate and precipitation is low, 11.52 inches annually. The high hourly wind movement and the low relative humidity act together to give a high evaporation. For the seven-month period, April through October, the evaporation averaged 71.81 inches; and the precipitation/evaporation ratio averaged 1 : 9. At an elevation of 6,200 feet, precipitation is approximately 9.5 inches; at 8,400 feet it is about 17.5 inches.

The growing season for range plants at the lower elevations is from mid-April to mid-October; at the higher elevations it is from early May to late September.

Physical Features

Surface Relief. The area is characterized by a wide range in elevation and topography. The lower portion is a flat to gently-undulating alluvial plain, which has been formed by the outwash materials from adjoining uplands. The plain is broken by old mesa remnants flanked by long slopes which grade into the true alluvial deposits in the valleys. The foothills west of this plain are characterized by many slope-gradients, numerous rock outcrops, rough-broken shale hills, and ephemeral streams which form a network of drainage channels. The mountainous area to the west is rough and steep, and lies within the Chusca mountain range.

Erosion. Erosion on the experimental area is severe. Owing to the high percentage of foothill and mountain topography and shallow soils, the area as a whole is highly susceptible to severe erosion by water. Although the smoother valleys and plains lying at the foot of the hills are affected only slightly by erosion, gully erosion has produced several deep arroyos. Many of the soils of lighter texture on the plains are subject to wind erosion.

Large volumes of floodwater and sediment are due to steep slopes, shallow soils, and sparse vegetative cover. Nearly every valley has at least one active gully, usually with several gully heads.

Erosion on the western half of the area is geologic, and over large areas all of the soil has been removed to bedrock. On the other half of the land surface, erosion is slight to moderate. Areas where erosion is nonexistent are negligible.

Table 1 -- Monthly averages of weather factors and soil temperature, Navajo Experiment Station, 1934-1942. Elevation: 6,437 feet

Month	Air temperature: Mean max.	Air temperature: Mean Min.	Air temperature: Mean	Soil temp. at 6-in. depth	Relative humidity	Hourly Wind Movement	Precipitation	Evaporation
	°F	°F	°F	°F	percent	miles	inches	inches
January	42.0	17.7	29.9	33.8	47.6	3.4	.61	
February	44.5	21.0	32.8	33.8	46.4	4.3	.85	
March	53.5	26.0	39.8	38.6	35.4	5.0	.80	
April	62.9	33.4	48.2	49.0	32.3	6.1	.56	8.59
May	74.3	41.7	58.0	58.1	28.2	5.3	1.08	12.24
June	84.2	48.9	66.5	68.3	24.9	5.3	.54	12.59
July	88.3	56.3	72.3	75.8	30.6	3.9	1.12	12.72
August	85.3	55.8	70.5	76.0	35.2	3.4	2.05	10.70
September	77.2	47.3	62.2	69.0	38.4	3.2	1.97	7.57
October	67.5	36.4	52.0	58.8	33.2	3.6	.73	6.40
November	53.6	26.5	40.1	46.0	37.0	3.6	.43	
December	44.7	21.1	32.9	38.5	44.4	3.1	.79	
ANNUAL	64.9	36.0	50.5	54.2	36.1	4.3	11.52	

Soils

The soils of the area are alluvial, colluvial, or residual and have been derived from Mesaverde sandstones and shales and, in the northwestern part, from Tohatchi sandstones and shales. The following series have been described:

Alluvial	Colluvial Phase	Residual
Crown	Crown	Buell
Oraibi		Pinedale
Wepo		Hopi
Concho		Chuska
		Floy

LAND RESOURCES

Agricultural Lands

In 1933, the entire acreage in cultivation on the 43,000-acre area was 257 acres, much of which was lying fallow. Most of these cultivated areas were located on alluvial fans and received supplemental water from flash floods. Some land was under cultivation at the higher altitudes (8,000 feet), where the average yearly precipitation of 17 inches was sufficient to produce good crops.

As a whole, most of the area is not well suited for general farming, either because of low rainfall or badly eroded soils. It was estimated in 1934 that, through the use of soil-conserving and water-conserving structures, the acreage could be doubled or even tripled. At present, however, only 326 acres are under cultivation.

Range Lands

With the exception of the small acreage under cultivation, the entire area is used for the grazing of livestock. Although grazing has been in progress since 1865, no great damage was reported from overuse until about 40 years ago. Since that time the intensity of use has increased. In July, 1933, it was estimated from the dipping records that from 3,400 to 5,000 sheep units grazed on the area. Of these, 3,499 sheep units were permanent and about 1,600 units were in transitory bands. The present stocking is 1,670 sheep units.

Water

There are no perennial streams on the area. Stock water, therefore, must be obtained from wells or surface reservoirs. Practically all of the main washes contain gravel bars from which a good supply of water can be obtained at shallow depths, usually less than 20 feet.

Several shallow wells and cross cuts now are producing water from these gravel bars. Moisture appearing at the surface in the beds of the washes cannot always be relied upon in the selection of well sites, since such a condition often shows only the shallow depth to the Menefee shales, which force the moisture to the surface.

The upper local sandstones of the Menefee have yielded water in small quantities in several places. The depth of most of the wells in these sandstones varies, according to location, from 30 to 60 feet. These sandstones are not considered dependable aquifers and should be utilized only when it is not practicable to obtain water from the gravels in the washes.

The lowest part of the area is in an artesian belt where flowing water can be expected at a depth of about 600 feet. Lesser amounts may be found at depths of from 125 to 300 feet. Wells of this depth yield two or three gallons per minute.

Wells and other watering places are spaced so that, on the average, stock travel less than two miles to water.

RODENTS AND PREDATORS

Neither rodents nor predators are a serious problem at present; some poisoning, however, has been carried out in different rodent control programs. The presence of a great number of coyotes throughout this entire country makes them always a menace to livestock. Bears are numerous in the mountainous western portion of the area, and there are a few bobcats and mountain lions.

METHODS

Range Survey

Since the number of surface acres required to support one unit of livestock varies widely with range conditions, information on the subject of forage acre requirement is necessary before any actual values for grazing capacity can be determined. The calculated grazing capacities for the area were based on an intensive range survey made in the spring of 1934. Arbitrary figures of three forage acres for a sheep and 12 for a cow were used.

Vegetation and Forage Survey

The vegetation on the experimental area falls into three major types:

1. Ponderosa pine type, in the extreme western portion. The most important forage species in this type are:

western wheatgrass	Agropyron smithii
blue grama	Bouteloua gracilis
mountain muhly	Muhlenbergia montana
cliffrose	Cowania stansburiana

2. Pinon-juniper type, in the central portion. Principal forage species are:

blue grama	Bouteloua gracilis
galleta	Hilaria jamesii
western wheatgrass	Agropyron smithii

3. Grassland-browse type, in the eastern portion. Principal forage species are:

galleta	Hilaria jamesii
blue grama	Bouteloua gracilis
alkali sacaton	Sporobolus airoides
chamise	Atriplex canescens

After the intensive range survey was completed in 1934, it was found that the actual grazing capacity was 1,881 sheep units or an approximate yearlong requirement of 23 surface acres for each sheep unit, and use of 1,670* animal units for the entire area was recommended. See Table 2, page 7.

Livestock

The livestock grazing the area in 1933 were of the poorest type. The sheep were long-haired animals weighing about 90 pounds and producing from 3½ to 4½ pounds of wool. Though some of the cattle showed signs of Hereford blood, they were mostly of the semi-feral, rangy, spotted type of animals prevalent in many parts of the Southwest and Mexico.

Because the area had been heavily overgrazed before the establishment of the station, reduction to proper numbers of the sheep, cattle, and other stock was the first step in the conservation program. After the area was fenced, therefore, all of the livestock was removed. Subsequently a reduced number of sheep, cattle, and horses were returned to the area for study and demonstration of the effects of proper livestock and range management on soil conservation.

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* The figure of 1,854 animal units used in Regional Bulletin No. 67 was based on preliminary recommendations of 1934.

Table 2 -- A comparison of the recommended use and the actual annual use of grazing units - 1934-1943.

Unit number	Total surface acres	Recommended Use April 1934 - April 1935			Actual Use April 1935 - April 1936			Actual Use April 1936 - April 1937			Actual Use April 1937 - April 1938			Actual Use April 1938 - April 1939			Actual Use April 1939 - April 1940			Actual Use April 1940 - April 1941			Actual Use April 1941 - April 1942			Actual Use April 1942 - April 1943		
		Animal days feed (sheep)	Grazing capacity sheep year-long	Class of live-stock	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation	Animal days feed (sheep)	Class of live-stock	Per-cent utili-zation
A	811	18,615	51	S	1,029	S	30	22,036	S	100		S	90	21,489	C	99	3,218	C	97	2,959	C H		7,472	C H	93		C S	70
B	611	14,235	39	S	0		0	8,848	S	70		S	79	13,586	C	100	9,311	C	88	9,933	C S		16,756	C S	80		C S	84
C	2,644	57,670	158	S	0		0	8,987	S	100		S	79	28,763	S	97	43,541	S	90	30,060	S		37,226	S	44		C S	101
D	196	6,935	19	S	0		0	0		0		S	89	6,999	S	116	8,792	S	180	3,775	S		7,572	S	91		C S	39
E	65	1,460	4	S	0		0	0		0			0	0		0	0		0		S		17,366	S	62		C S	0
F	4,818	62,587	171	C	35,952	C	50	35,952	C	50		C	103	96,498	C	115	19,388	C	99	45,288	C H		65,504	C H	62		C S	73
G	3,206	66,795	183	S	0		0	0		0		S	84	49,129	C	108	45,492	S	103	69,804	C S		23,939	H S	68		C S	110
H	510	12,045	33	S	0		0	0		0		S	71	1,380	S	100	0		0		C S		487	H	68		C	110
I	668	15,695	43	S	0		0	0		0			0	0		0	0		0	1,527	C S		820	H	5		C	110
J	641	18,250	50	H	18,250	H	100	18,250	H	100		H	105	9,785	H	100	8,680	H	102	5,110	S		4,206	H	91		H	61
K	4,441	70,080	192	S	0		0	0		0		S	85	49,142	S	99	12,174	S	114	20,858	S		45,087	S H	88		C S	114
L	2,811	26,280	72	S	0		0	0		0		S	65	25,128	C	102	8,867	C	115	6,317	S		780	H			C S	85
M	5,135	57,305	157	S	0		0	0		0		S	82	57,696	C	97	47,932	S	112	38,477	C H S		72,035	S H	85		C S	90
N	5,620	32,850	90	S	0		0	0		0		S	65	99,780	S	94	35,514	S	151	17,594	C H S		19,473	C S	100		C S	96
1	2,120	48,545	133	S	19,273	S	75	42,808	S	100		S	82	45,132	S	103	18,927	S	100	21,366	S		43,167	S	100		C S	88
2	2,626	62,780	172	S	51,622	S	75	57,769	S	90		S	55	75,467	S	110	92,783	S	102	62,156	C S		127,020	S C	94		C S	92
3	1,609	28,470	78	S	23,478	S	75	30,390	S	70		S	70	24,439	S	93	40,946	S	83	50,011	S		30,643	S	96		C S	110
4	2,409	58,765	161	S	30,750	S	60	56,630	S	60		S	70	46,944	S	94	46,760	S	153	50,239	S		78,623	S	76		C S	92
5	2,124	22,265	61	S	19,805	S	75	26,838	S	60		S	84	24,577	S	97	39,937	S	120	33,179	C S		47,485	C S	82		C S	113
6	747	5,110	14	S	576	S	75	2,340	S	40		S	43	10,611	S	110	0	S	0	11,675	S		15,096	S	130		C S	117
TOTALS	43,812	686,737	1,881		200,735			310,848			511,000			691,547*			482,262			480,328			660,757			606,757		

Data not secured by individual units

Data not taken

Data not secured by individual units

* Includes an estimated 5,000 unapportioned sheep days from trespassers

Since it was imperative in carrying out the soil and water conservation measures that the economy of the people living on the area be dislocated as little as possible, a livestock improvement program was made a part of the demonstration. Purebred Rambouillet sheep and purebred Hereford cattle were introduced, and improvement of the production of a herd of grade sheep by the use of purebred rams was initiated. Of the 1,670 sheep units, 500 were purebred Rambouillets and 500 were mixedbred or grade sheep. Purebred Hereford cows made up 320 sheep units, and 350 sheep units were in miscellaneous stock such as horses, rams, and bulls. It was from this latter group that fluctuations in total numbers occurred after 1936.

The purebred sheep grazed the area for the nine-year period, 1935 to 1943. The grade sheep were introduced to the station range at the same time; but the improvement program was not begun until 1937. Although the period 1937-1943 was not long enough for the breeding improvement program to bring final results in increased production, the production of these sheep at the end of this time was approaching that of the purebred herd. In 1935, the wool clips for the two classes of sheep were: purebreds, 12.5 pounds per head; grades, 4.9 pounds. In 1942, these values were, respectively, 10.5 pounds and 7.8 pounds per head.

In addition to records on the livestock within the area, similar information has been obtained on yields and returns from typical livestock on similar but unprotected range.

For simplifying the comparison of returns under proper management within the area with those under ordinary management outside, the former number of sheep units grazing the area was taken as 3,340. The livestock and range management program included both cattle and sheep, because it was left that in an area of this size, with such a varied topography, several different combinations of grazing practices could be used to the best advantage.

RANGE MANAGEMENT

Livestock Distribution

To obtain proper distribution, an important step in bringing about optimum range use, sub-units were set up within the area, and the range plan was based upon these sub-units.

ANIMAL MANAGEMENT

Loose or open herding was practiced; and the bands of sheep were grazed, rather than driven, to and from water. When weather conditions were favorable, the bands were turned off the bed-ground as

early as possible, or soon after daylight. They were routed, herded, and bedded at all times in such a manner and in such places as to result in a minimum of trampling and an even utilization of forage over the entire unit. Corrals were used only in working the bands and in emergency cases, such as protection from predators, etc.

Sheep received all the salt they would eat, which amounted to an annual consumption of 45 pounds per head.

Rams were placed with the ewes about December 10, and were left for a period of 35 days.

The bands were moved to the lambing range at least 10 days before the dropping period started. Lambing started about May 5, and was completed by June 15.

Shearing was done with power-driven equipment and required from 10 to 12 days. After shearing, the ewes were dipped in a bentonite sulphur dip and moved to the summer range.

RESULTS

Range Recovery

The recovery of the range within the experimental area is probably of more significance to the long-range conservation program than are the livestock returns. Gullies with little or no treatment everywhere were healing through the stabilization of their bottoms and sides with grass. The effect of stocking differences were clearly visible along the fence line, and volume production of forage was so great as to give a mistaken impression of a marked increase in density. That the amount of feed increased as a direct result of this volume growth is certain, but the advisability of increasing the number of animals based on volume growth without a greater increase in density than occurred is questionable except for short periods. This is indicated by the record of the animal day's feed used in the different years (Table 2, page 7). Even after 10 years, range technicians doubted the possibility of showing any great difference in vegetative density through another intensive range survey.

Certain small areas increase in density manyfold; but actual increases in density for the range as a whole were relatively small. A verification of this statement is shown in Tables 3 and 4, pages 10 and 11. In 1934 and 1935, numerous plots were established at various points over the area and in different vegetative types. In each type, half of the plots were closed to livestock and the remainder were grazed in accordance with the standard set for the unit in which they were located. Ten such plots varying in size from a third of an acre to three acres were established in 1934.

Table 3 -- Frequency indices from plots in two galleta grass types at an elevation of 6,300 feet

Species*	Galleta-alkali sacaton type								Galleta-blue grama type							
	Grazed				Ungrazed				Grazed				Ungrazed			
	1934		1943		1934		1943		1934		1943		1934		1943	
	1 m^2	.1m	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2
Hilaria jamesii	100	84	100	96	100	90	100	92	100	88	100	70	100	78	96	64
Sporobolus airoides	76	48	78	52	62	36	48	28								
Bouteloua gracilis	0	0	4	0					84	70	98	64	88	46	98	70
Monroa squarosa	100	90	0	0	84	46	0	0	20	4	0	0	22	8	0	0
Portulaca cleracea	100	90	0	0	90	58	0	0	28	10	0	0	36	8	0	0
Gutierrezia sarothrae									86	24	98	42	86	18	92	52
Sporobolus cryptandrus	0	0	8	0	0	0	8	0	40	18	14	0	32	16	0	0
Aristida longiseta									12	6	14	6	6	0	20	12
Salsola pestifer	12	6	32	12	8	6	24	12	6	0	0	0	6	12	18	8
Aster arenosus									4	4	18	2	8	0	54	18
Schedonnardus paniculatus	4	0	0	0	6	0	12	4								

* Nine species with indices of less than 10 have been omitted.

Table 4 -- Frequency indices from a grazed and an ungrazed plot in a ponderosa pine type at an elevation of 8,400 feet.

Species*	Grazed plot				Ungrazed plot			
	1934		1943		1934		1943	
	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2	1 m^2	.1 m^2
Actinea richardsoni	100	83	84	30	100	91	53	17
Erigeron flagellaris	88	53	92	74	74	43	85	69
Polygonum sawatchense	82	54	15	3	69	36	3	0
Plantage purshii	79	43	54	21	49	15	27	13
Sporobolus cryptandrus	54	21	4	0	38	7	3	11
Chrysopsis villosa	38	9	80	47	38	7	86	52
Sitanion hystrix	31	7	94	46	36	8	51	19
Bouteloua gracilis	22	12	19	9	29	16	33	8
Allium cernuum					16	0	1	0
Gilia multiflora	2	0	14	5	14	2	42	11
Lupinus aduncus	27	4	91	68	10	3	96	62
Pentstemon jamesii	41	10	65	33	9	1	29	10
Thlaspi fendleri	4	1	16	8	6	0	0	0
Artemisia wrightii	9	0	23	7	5	0	14	4
Festuca arizonica					4	0	11	3
Orthocarpus purpureo-albus	4	0	20	1	4	0	34	5
Koeleria cristata	3	1	17	4	2	0	8	3
Muhlenbergia montana	14	5	18	7	2	0	6	0
Bahia dissecta	0	0	1	0	0	0	11	1
Erigeron divergens	0	0	14	1	0	0	4	1
Erigonum alatum	1	0	12	7	0	0	32	11
Hymenopappus filifolius	2	0	9	4	0	0	11	2
Senecie neomexicanus	1	0	18	6	0	0	2	0

* Twenty-nine species having indices of less than 10 are omitted.

Table 5 -- An analysis of range use*

	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43
Weighted average of annual estimates of use in the areas actually grazed (In percent of available feed)	70	77		102	110		83	
Ratio of actual use to the original survey (In percent)	68	71	76	103	74	71	96	88
Original estimate of a.f.d. (sheep) in areas grazed	325,387	397,292	669,582	669,582	652,427	673,232	686,737	686,737
Yearly estimate of a.f.d. (sheep) in areas grazed	323,766	401,612	---	676,660	437,624	---	798,981	---
Fluctuations from original estimate in a.f.d. (sheep) (Annual estimate minus original estimate)	-1,621	ǂ4,320	---	+7,078	-214,803	---	+112,244	---
Fluctuations from original estimate in sheep units	-4	+12	---	+19	-589	---	+308	---
Fluctuations from original estimate (In percent)	-0.5	+1.1	---	+1.1	-33	---	+16	---
Annual precipitation	11.74	10.31	10.12	9.87	8.47	15.15	20.08	6.02

* For the calculations used in preparing this table, it is assumed that both the estimate of the original survey and the yearly estimates of use are correct. Differences between these two estimates of sheep days feed, therefore, represent fluctuations in forage production during a given year. Fluctuations above the original estimate (+ fluctuations) reflect conditions better than the estimated normal; while those below this estimate (- fluctuations) reflect poorer conditions than the estimated normal.

The vegetation in these areas was measured by the frequenty index method then and again in 1943. Since the vegetative responses were practically the same at the end of 10 years, only two examples have been used. (Tables 3 and 4, pages 10 and 11). As may be seen in the tables, little change in abundance or vegetative composition has taken place.

Range Use and Forage Responses

The forage use within the area has varied widely within the last eight years, (Table 2, page 7). A comparison between estimated possible use, actual use, and the utilization checks shows the relationship which exists between the original survey and the annual utilization check, (Table 5, page 13). It appears from the data in the table, that there is reasonably close agreement between surveys, but variations such as existed in 1939 -- a drought period -- must be expected. This indicates that original surveys cannot be followed blindly, but must be tempered with judgment from season to season, since an abnormal year, or a succession of such years, causes wide variations in the amount of forage produced. Thus, even proper use in preceding years may not always provide a sufficient "carry over" of forage if adverse weather conditions are too extreme or too protracted.

Owing to the fact that livestock weights within the area were above the average for the region; and, as is illustrated by Tables 3 and 4, (pages 10 and 11), the vegetative cover was not decreasing, it may be assumed that the original survey was correct, or at least the grazing capacity of the range was not overestimated. It can be assumed further from the same reasoning that the sum of tha annual utilization surveys also has been correct, or reasonably so. If, then, these two evaluations have been correct, there exists, in the final analysis, a series of values presented in Table 5, page 13, as animal days' feed based on annual estimate of use and variations from the original survey. These values indicate a small variation -- five percent -- from the original recommended use, and they indicate further that the area has been properly utilized over the last eight years. They show also that proper range use can be had through the application of range survey technique to, but not necessarily designed for, a given section of the country.

Livestock Returns

Nine years of proper livestock management showed that some livestock owners living within the demonstration area were able to reduce the number of their livestock by half, run purebred sheep and cattle, and raise their level of income; whereas the rest of the ranchers were able to reduce their livestock by half, improve the remainder, and maintain their level of income. Tables 6 and 8, pages 14 and 16, show the results which were obtained from purebred and grade sheep as compared with the prevalent management of grade stock outside the demonstration area.

Table 6 -- Livestock statistics (sheep) - 1935-1942

SOURCE	Unit	DATE 1935	1936	1937	1938	1939	1940	1941	1942
Improved Rambouillet Sheep Inside Experimental Area									
Lamb crop	percent	79	85	92	100	102	103	84	92
Average fleece weight	pounds	12.3	9.9	11.0	12.0	10.0	10.5	10.2	10.5
Average lamb weight *	pounds	56	60	65	68	71	70	70	64
Average death loss	percent	9	4	5	4	6	4	6	6
Price of wool per pound	cents	17	17	27	15.5	18.5	23	31	37.5
Price of lambs per pound	cents	7	7	10	5.5	7	10	14.5	15
Crossbred sheep inside area									
Lamb crop	percent	92	69	70	70	75	90	90	90
Average fleece weight	pounds	4.9	4.5	4.5	5.0	4.9	6.8	6.4	7.8
Average lamb weight *	pounds	50	55	50	60	63	54	61	63
Average death loss	percent	3.6	7.0	8.0	4.0	10.0	8.4	5.5	5.9
Price of wool per pound	cents	16.5	16.5	25	13	16.5	21	31	32
Price of lambs per pound	cents	5.5	5.5	9	4.5	6.2	7	10.2	11
Crossbred sheep outside area									
Lamb crop	percent	69	49	50	60	50	72	70	97
Average fleece weight	pounds	4.2	4.0	4.0	4.0	4.5	5	5	6
Average lamb weight **	pounds	49	52	48	51	50	58	61	64
Average death loss	percent	15	14	12	15	14	12	12	12
Price of wool per pound	cents	16.5	16.5	25	13	16.5	21	28	32
Price of lambs per pound	cents	5.5	5.5	9	4.5	5.5	7	9	11

* Age of lambs 6 months
** Age of lambs 7 months

Table 7 -- Livestock statistics (cattle) - 1938-1942

SOURCE	UNIT	DATE				
		1938	1939	1940	1941	1942
Inside of Experimental Area						
Calf crop	percent	94	94	80	100	83
Average bull calf weight	pounds	410	490	503	479	466
Average heifer calf weight	pounds	--	435	455	467	464
Average calf weight *	pounds	410	462	482	473	465
Price received for calves per lb.	cents	5.5	9	10	10	12.2
Death loss	percent	0	2	1.5	1	0
Outside experimental area						
Calf crop	percent	-	60	50	60	55
Average bull calf weight	pounds	-	-	-	-	-
Average heifer calf weight	pounds	-	-	-	-	-
Average calf weight **	pounds	-	350	300	400	375
Price received for calves per lb.	cents	-	6	7	8	10
Death loss ***	percent	-	-	10	10	10

* Age of calves 7 months
** Average age of calves 8 months
*** District average

Table 8 -- Comparison of livestock yield

Type of Livestock	Crop Production (percent)	Average death loss (percent)	Average fleece weight (pounds)	Average animal weight at selling (pounds)	Average price of wool per lb. (cents)	Average price of livestock per lb. (cents)	Income per unit (dollars)
Purebred sheep inside of area	92.1	5.4	10.1	66	23.3	8.4 *	8.06
Crossbred sheep inside of area	80.8	5.4	5.7	57	21.4	7.4	4.56
Crossbred sheep outside of area	64.5	13.2	4.6	54	21.1	7.1	3.29
Purebred cattle inside of area	90.0	1.1	-	457	-	9.3 *	38.29
Crossbred cattle outside of area	45.0	7.5	-	356	-	7.8	11.05

* Values based on weather lamb and steer prices rather than on bull and ram lamb prices shown in table.

Because of the expense involved, it is not expected that all ranchers should convert to purebred sheep, since according to Table 6, page 14, by the use of careful breeding, production may be rapidly increased at very little additional expense. It took only six years of moderately careful breeding and selection for the grade herd to approach the level of production of the purebreds.

Results from proper cattle management are shown in Tables 7 and 8, pages 15 and 16.

In view of the fact that the size of the experimental area is about that of a medium-sized ranch and that the stock on the area were managed as a single enterprise, the returns are discussed from this standpoint. The average gross return for all kinds of livestock, after being converted to sheep units, was $6.51 per unit; whereas the gross return per sheep unit on the outside of the area was $3.30. These figures are based on 1,670 producing sheep units on the demonstration range. Since there was little reduction in numbers of stock outside of the demonstration area as compared to a 50 percent reduction inside, the income from one sheep unit inside must be compared with that from two sheep units outside. The income from comparable areas inside and out, therefore, was essentially the same -- $6.51 on the inside and $6.60 on the outside. In interpreting the long-range significance of these figures, however, it should be borne in mind that the range inside the area was improving while that on the outside was rapidly deteriorating. Also the extra expense and labor involved in handling the greater numbers of livestock on the outside tended to detract from the profit. Tables 6, 7, and 8 (pages 14, 15, and 16), show the difference in livestock yield and cash returns between poor and proper livestock management.

Since many ranchers figure their returns on an acre basis, it might be enlightening to consider the foregoing information on that basis, not only for the actual returns but also for the greatest possible returns which might have been gained had a good class of livestock been used throughout the demonstration. The results show that, under proper management, the demonstration area produced 19 cents per acre for the cooperators. Although each acre on the outside likewise produced 19 cents, the much greater number of livestock not only required considerably greater amounts of salt, water, and labor, but also caused rapid deterioration of the range. The range in the demonstration area, on the other hand, was improving. If all sheep on the demonstration area had been of high quality, the acreage return would have been 21 cents, or 10 percent more than that on the outside. Since high quality animals have been unable to survive well on the badly overgrazed ranges outside the demonstration area (determined by actual test and observation), the figure of 19 cents per acre for the hardened sheep on the outside must be used for the comparison.

SUMMARY

The over-all benefits of ten years of range conservation have been presented. Increased livestock yields and cash returns resulted from practices involving:

1. Avoidance of overgrazing by livestock.
2. Proper distribution of livestock.
3. Improvement of livestock through breeding.
4. Proper handling of livestock at breeding, lambing, dipping and shearing.

Range recovery as a direct result of these practices was greatest in plant vigor, which was reflected in the volume of forage produced. Increase in the density of ground cover was most striking at points of water concentration, such as gully bottoms and alluvial flats.

Proper range control practices recommended by the Soil Conservation Service in 1934, and adapted to northwestern New Mexico, were used without change for nine years and were found applicable to the study area.

The demonstration showed that it is possible to maintain or even to increase income and at the same time to improve the range and to conserve soil and water through intelligent livestock management and conservative grazing.

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